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Shimizu

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(54) **BALUSTRADE DEVICE FOR CONVEYOR**

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B66B 23/22 (2006.01)

(52) **U.S. Cl.**
CPC ***B66B 23/22*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A balustrade device for a conveyor includes at least a holder body, a clamping component assembled to the holder body, and a clamping force applying mechanism. The clamping component has a panel-side pressing surface, and the clamping force applying mechanism has a clamping force action axis intersecting, in vertical cross-sectional view, with the panel-side pressing surface or a plane extending from the panel-side pressing surface. Thus, a high gripping force can be generated in spite of a two-dimensional shape of the balustrade device.

5 Claims, 19 Drawing Sheets

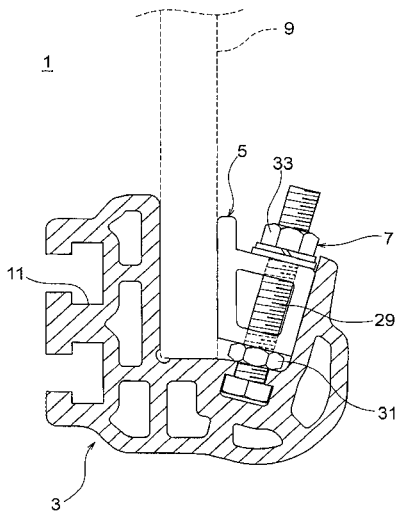


FIG. 1

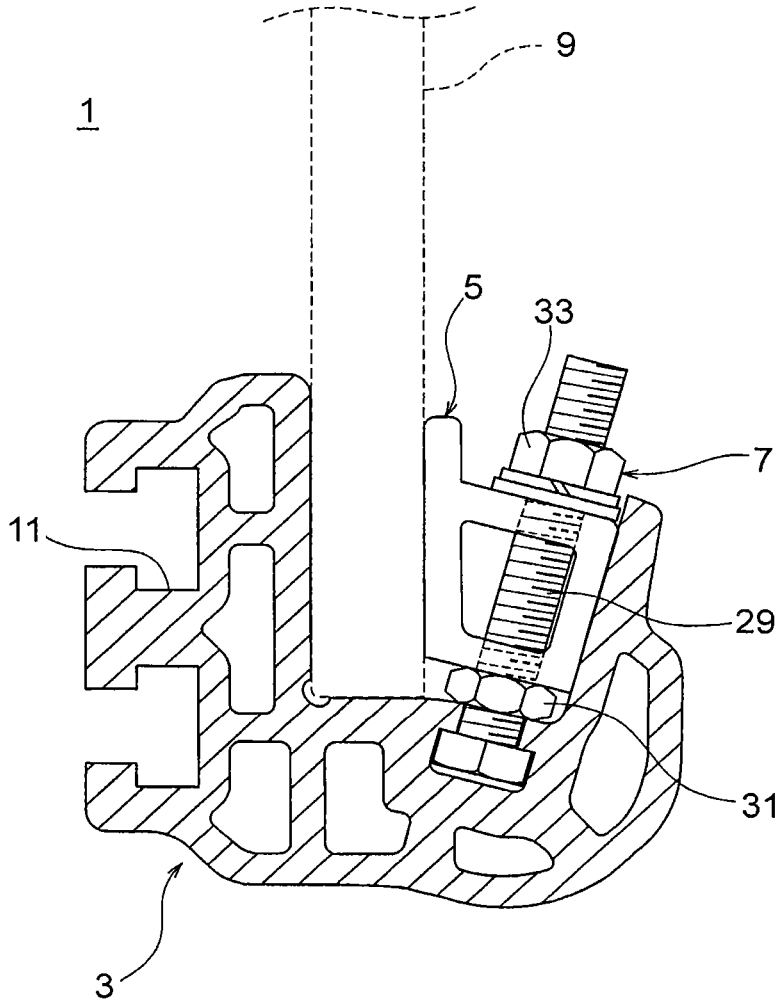


FIG. 2

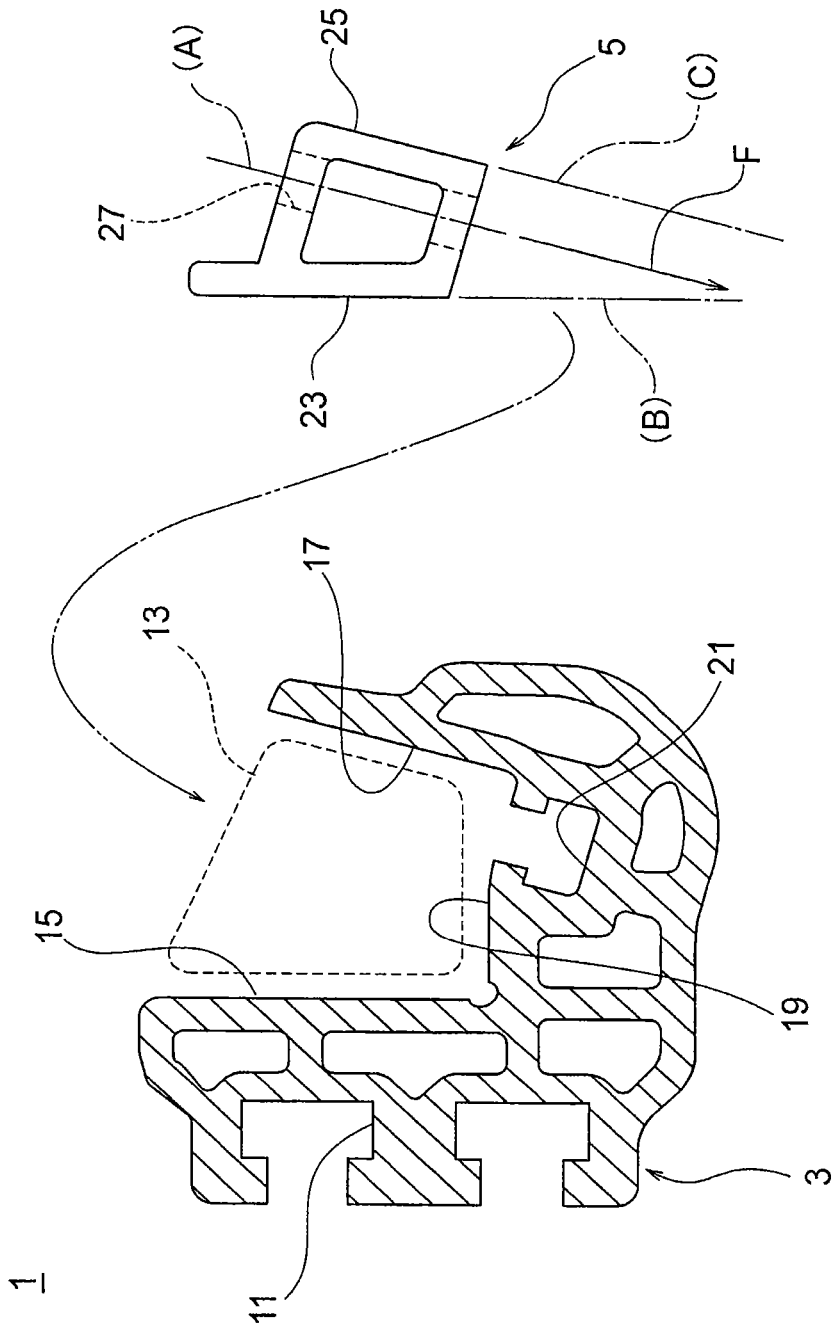


FIG. 3

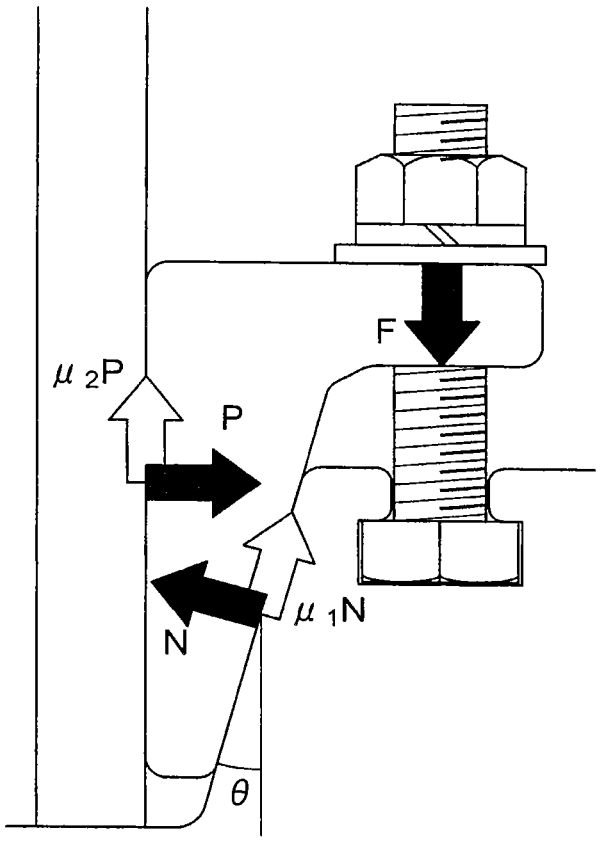


FIG. 4

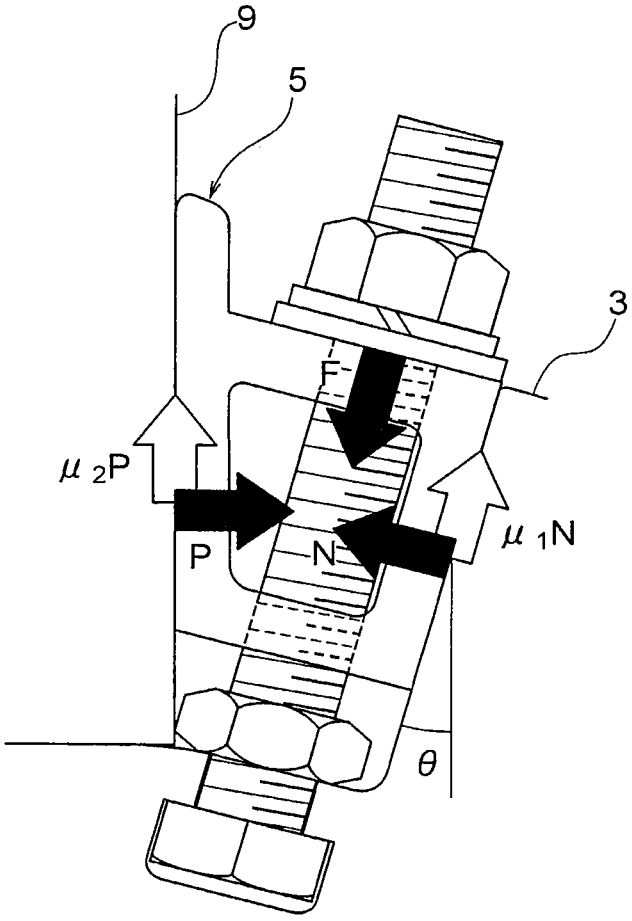


FIG. 5

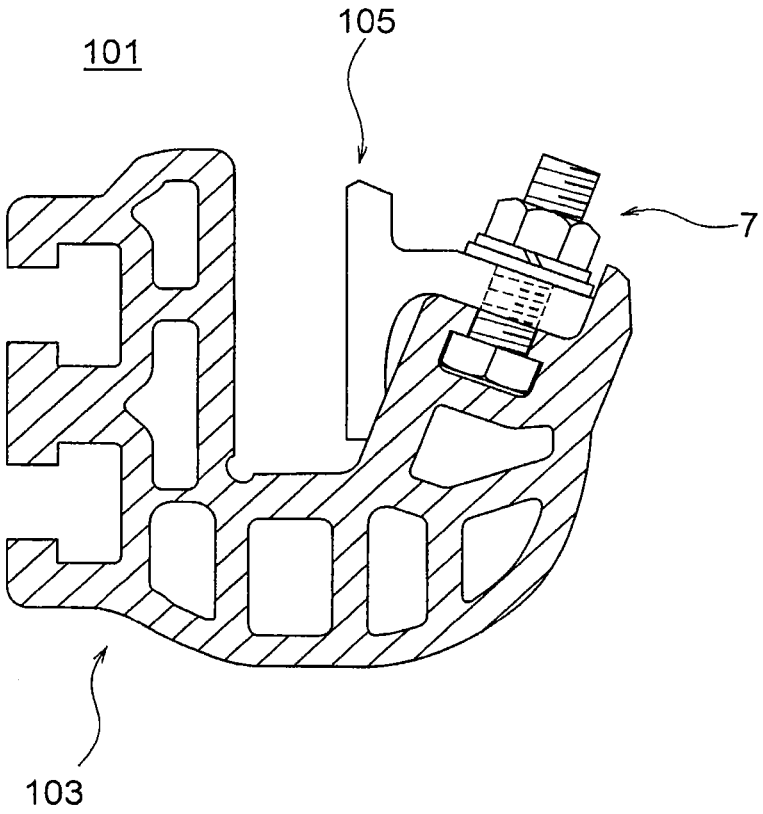


FIG. 6

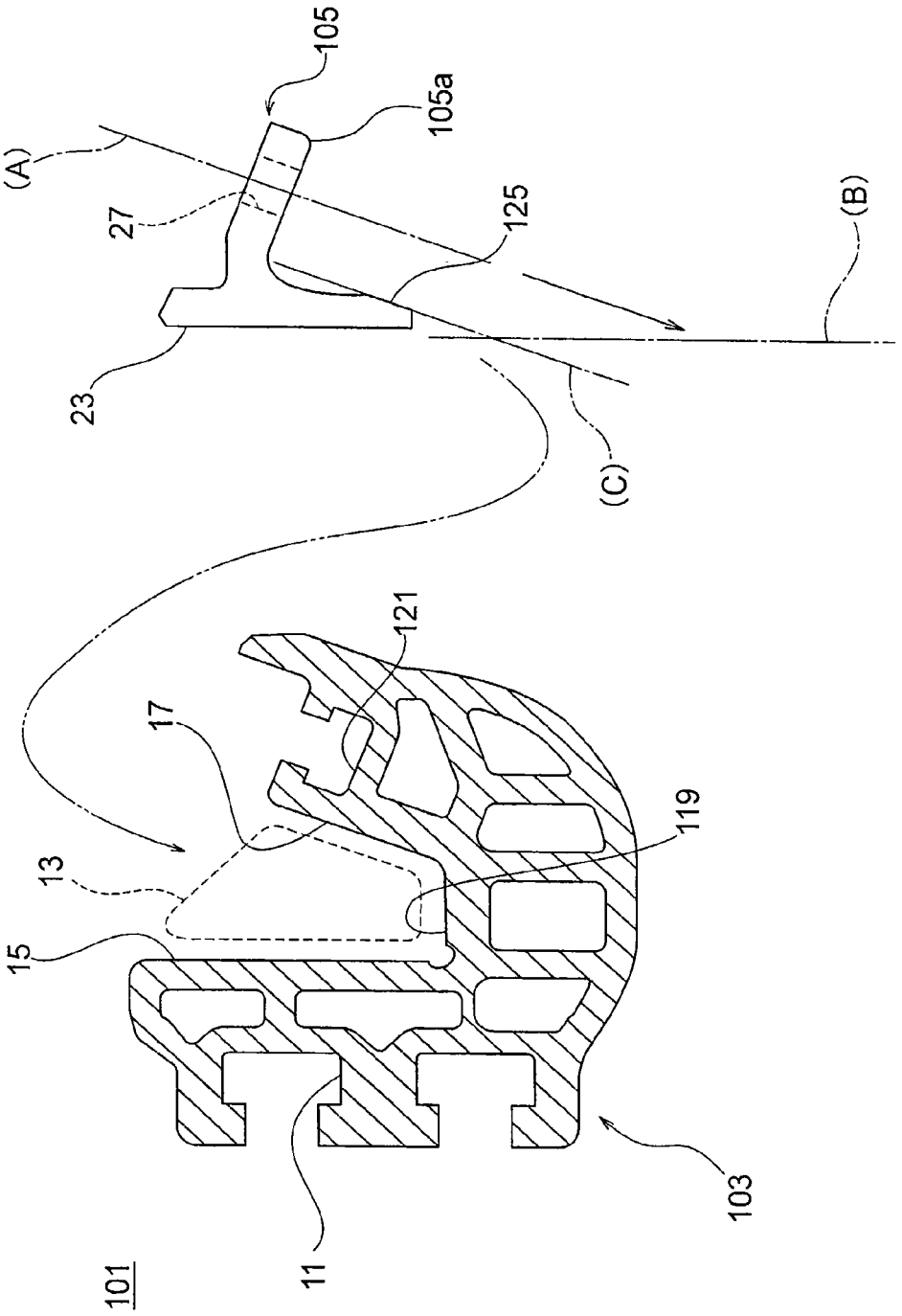


FIG. 7

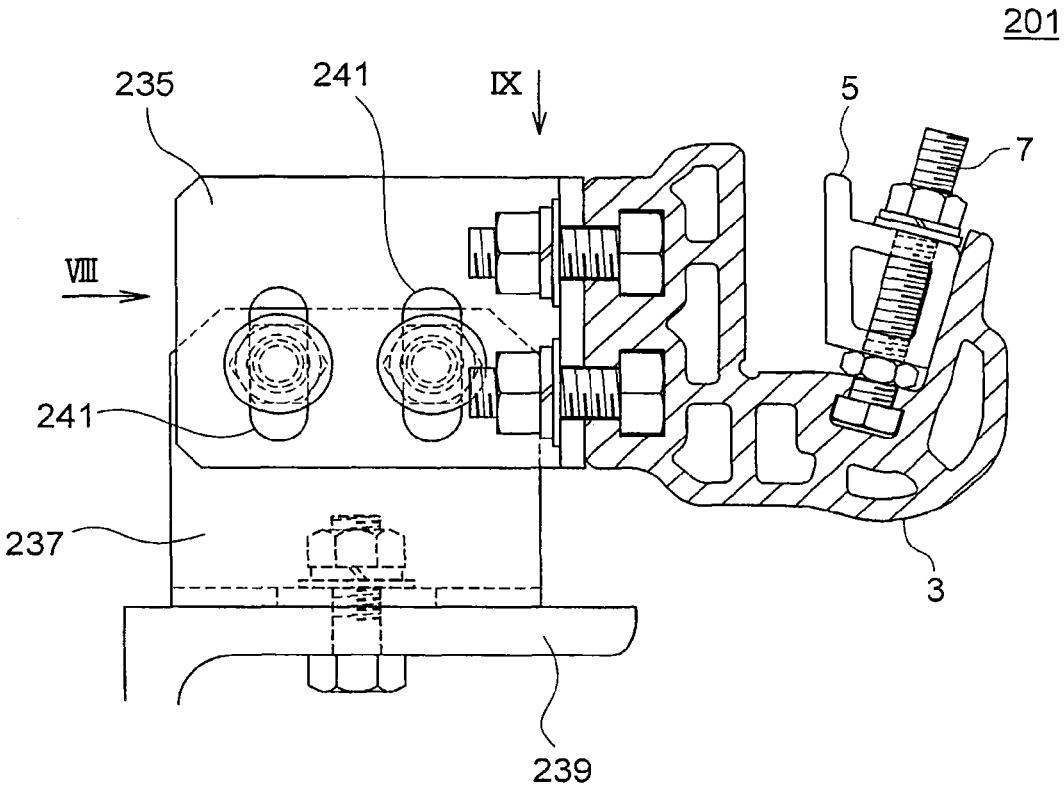


FIG. 8

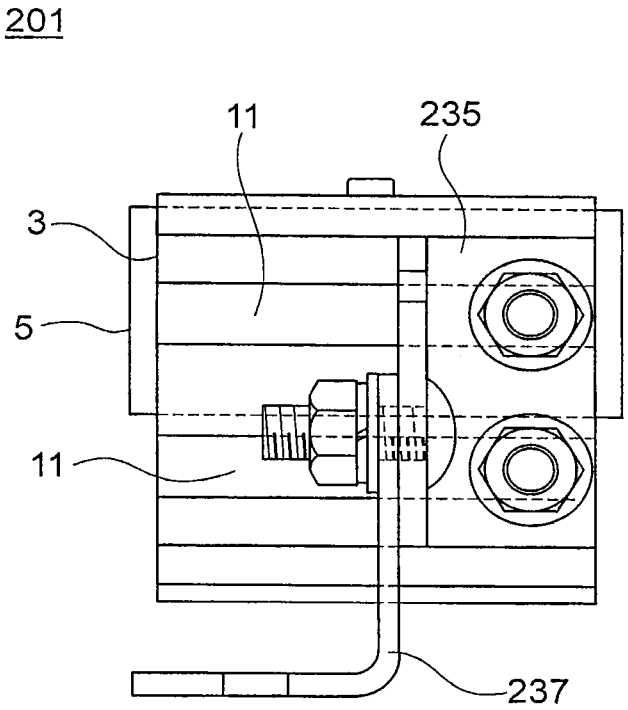


FIG. 9

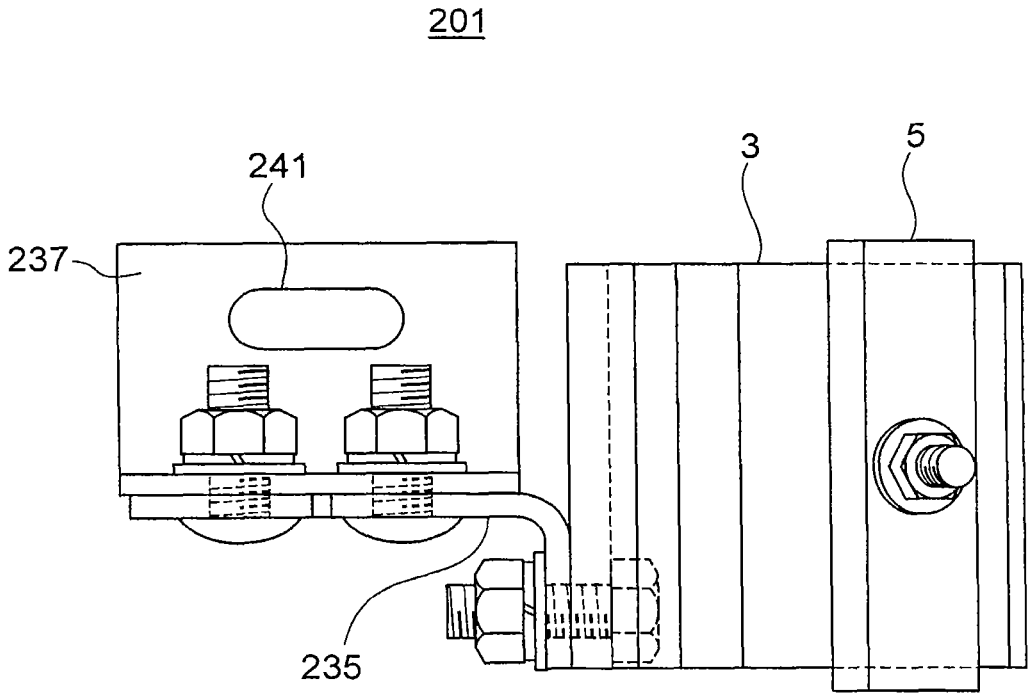


FIG. 10

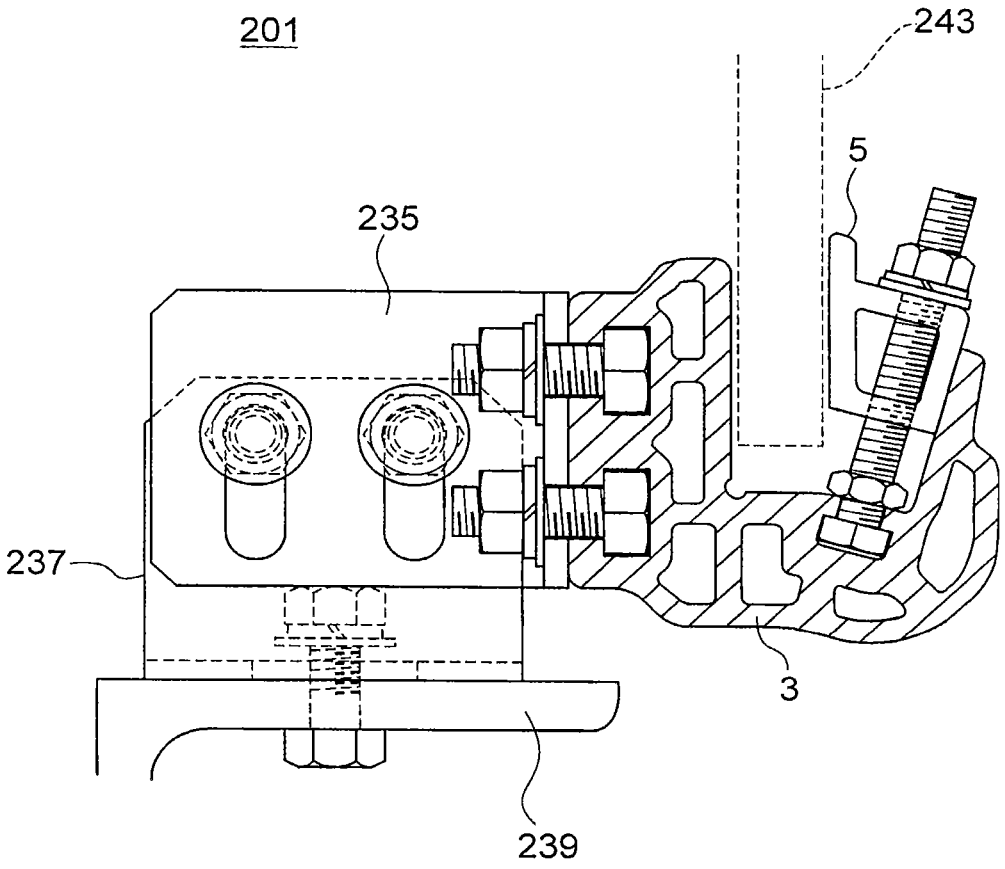


FIG. 11

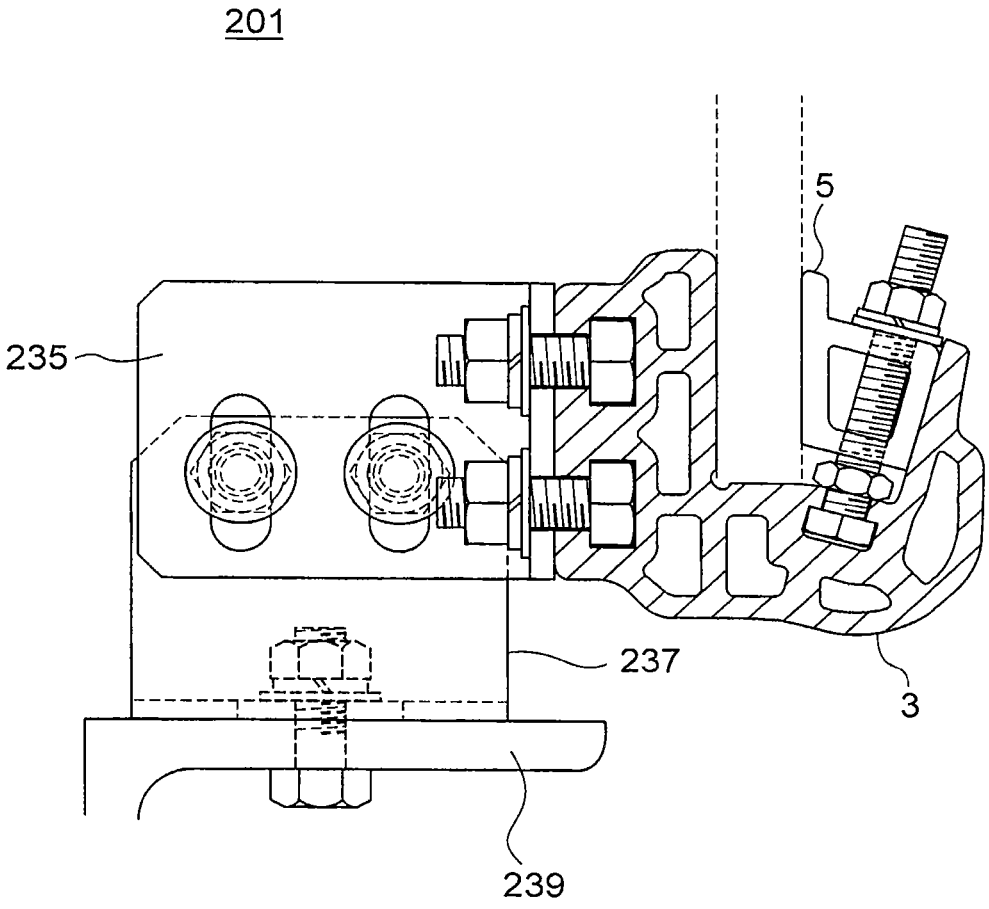


FIG. 12

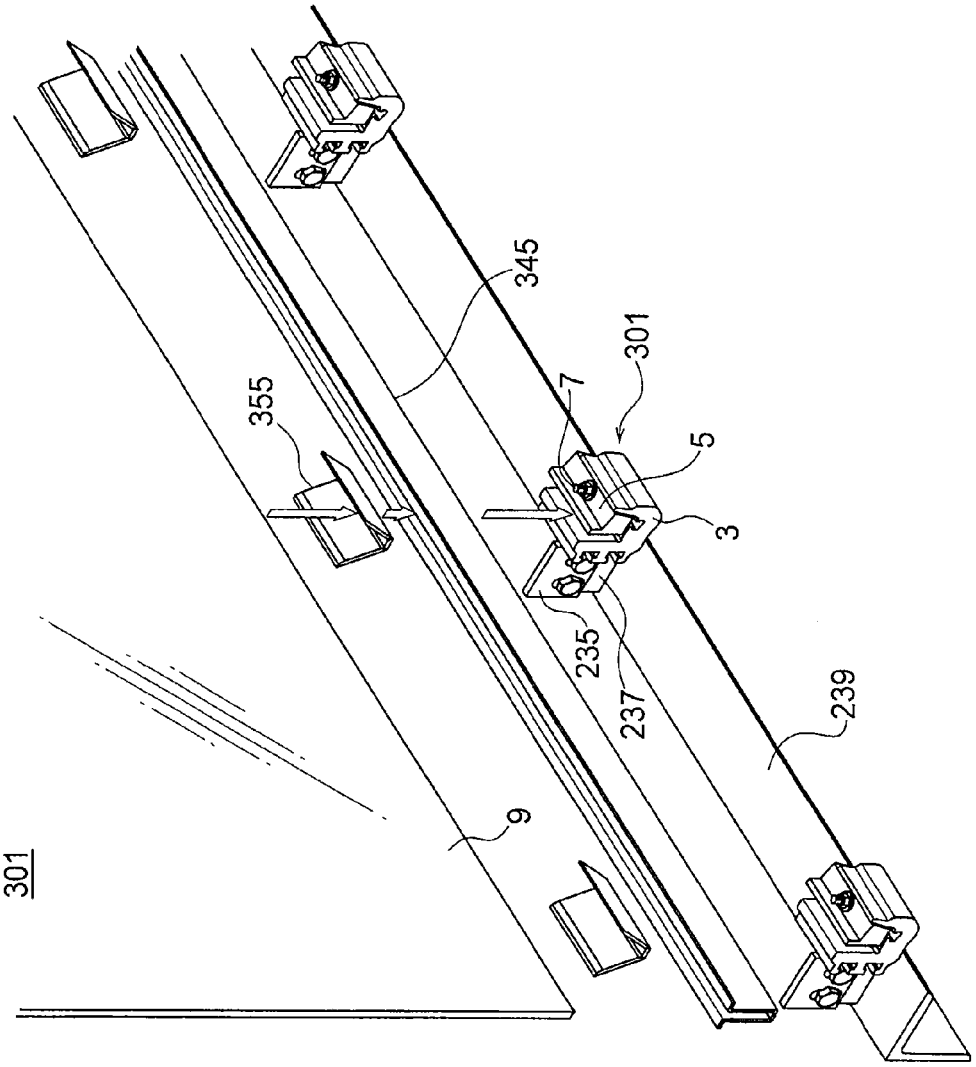


FIG. 13

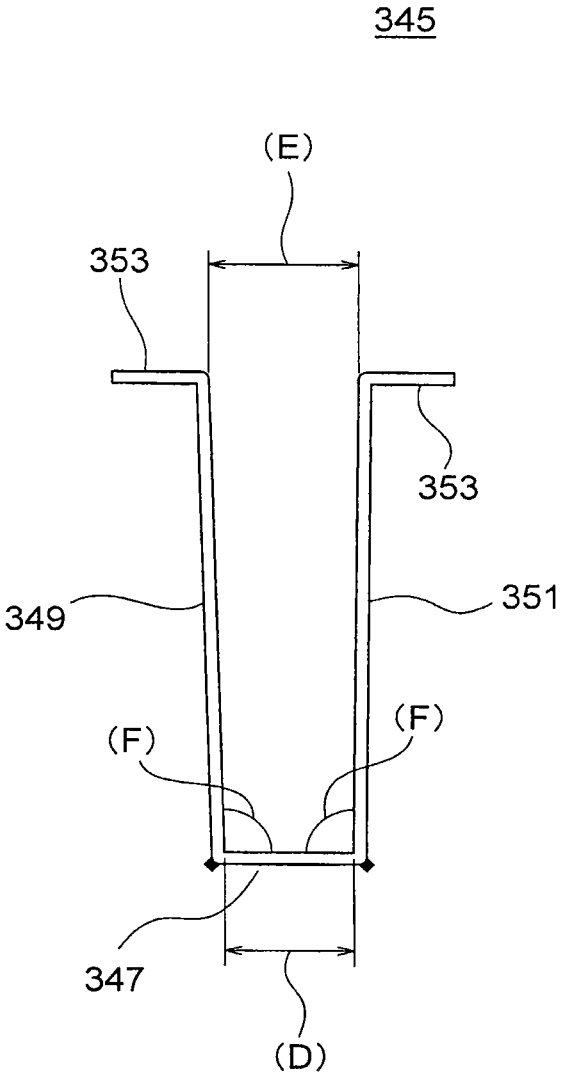


FIG. 14

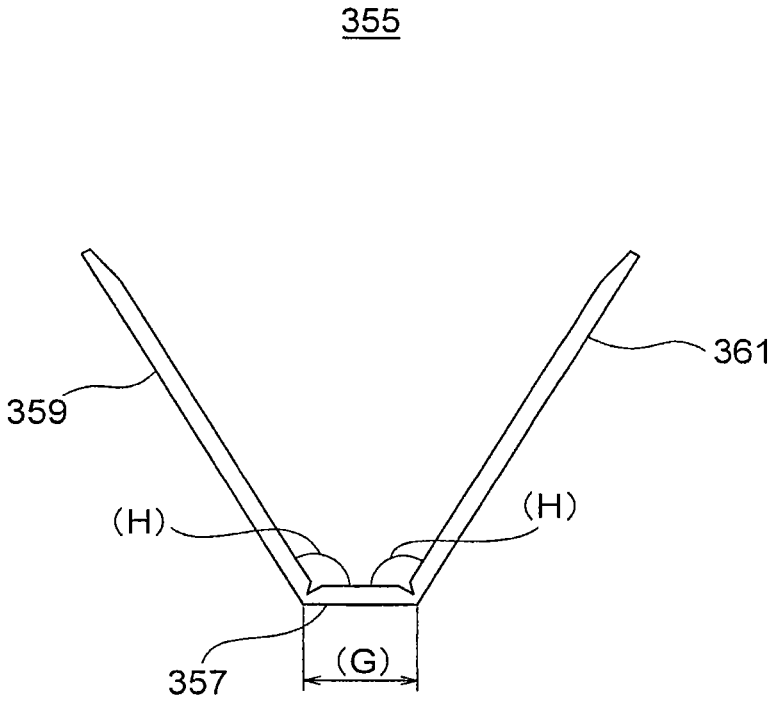


FIG. 15

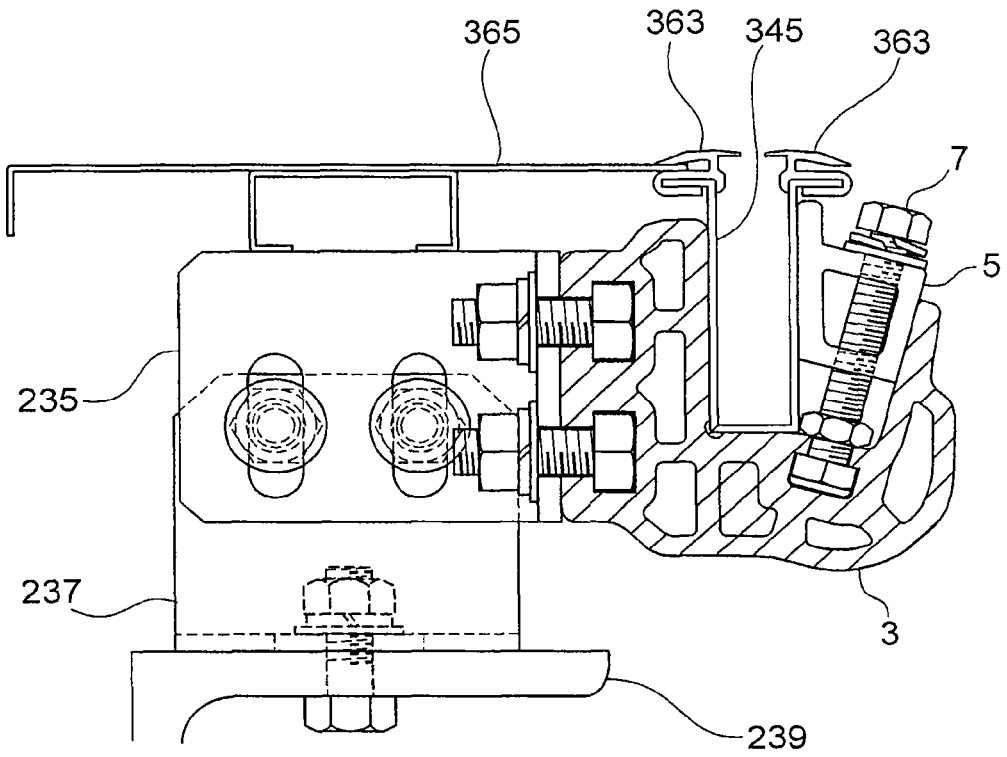


FIG. 16

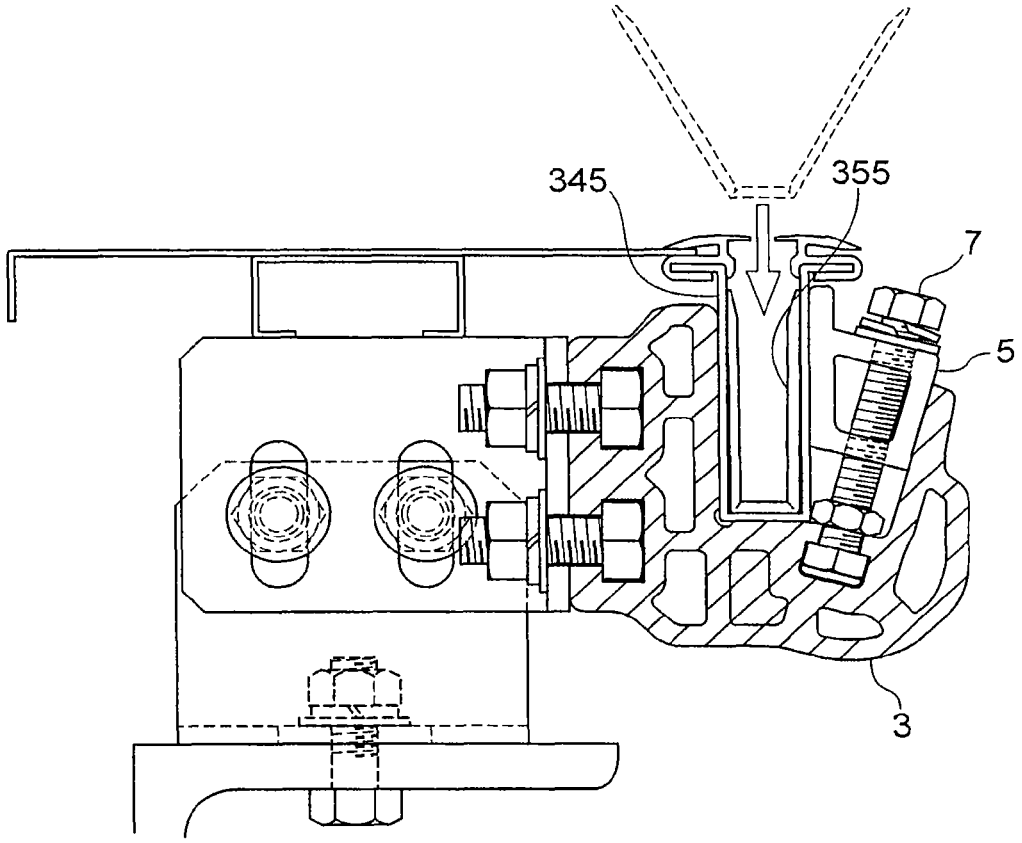


FIG. 17

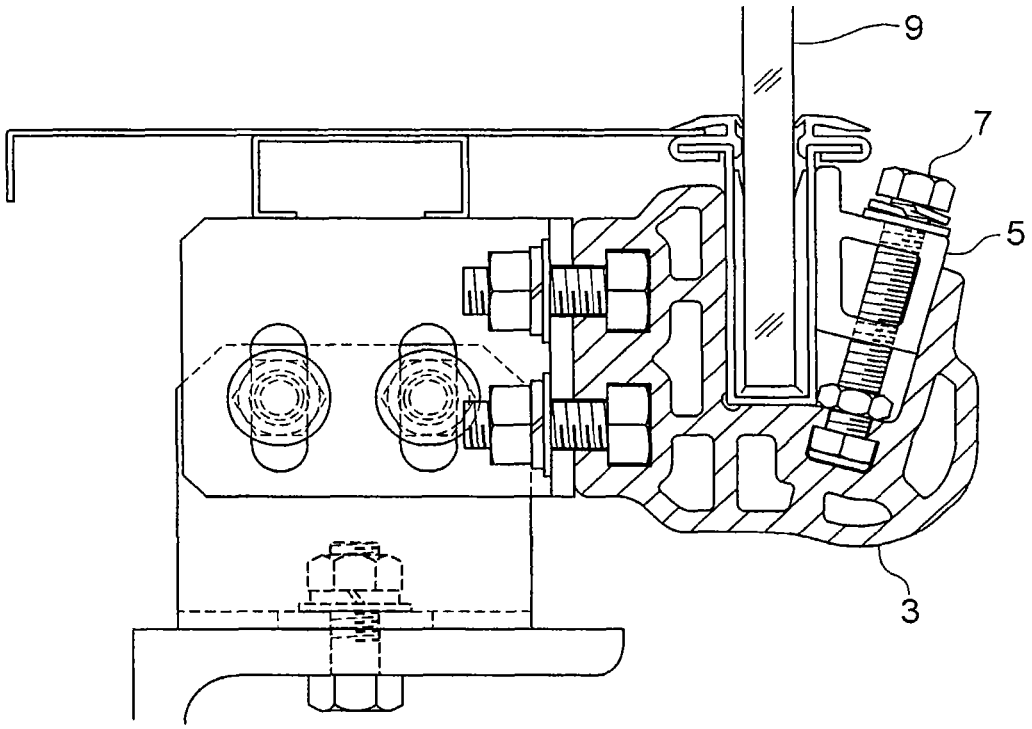


FIG. 18

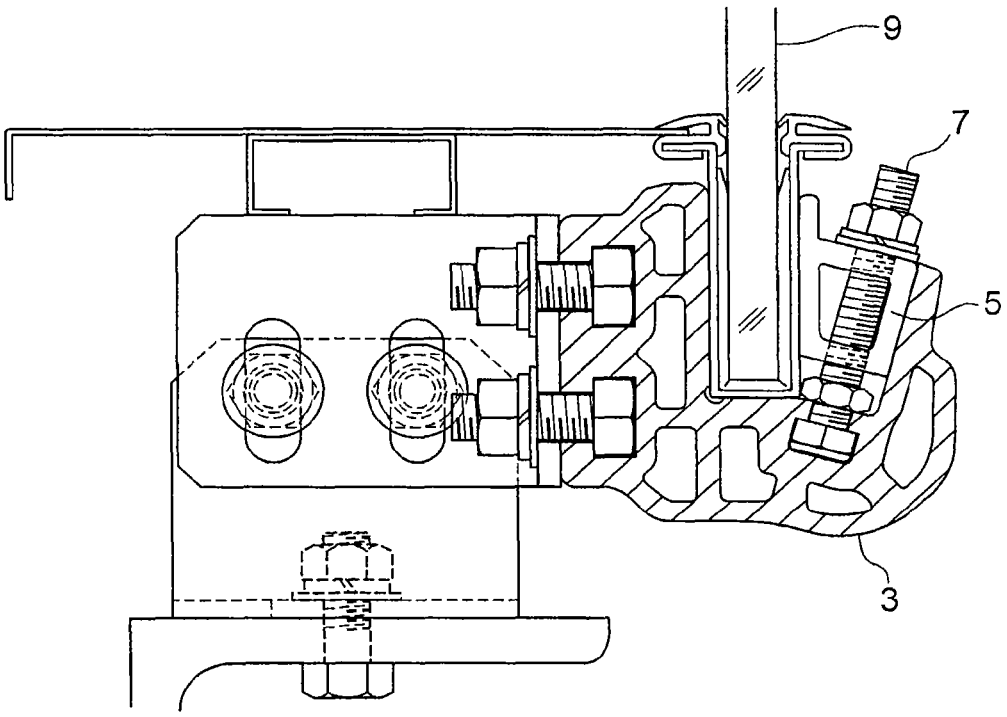
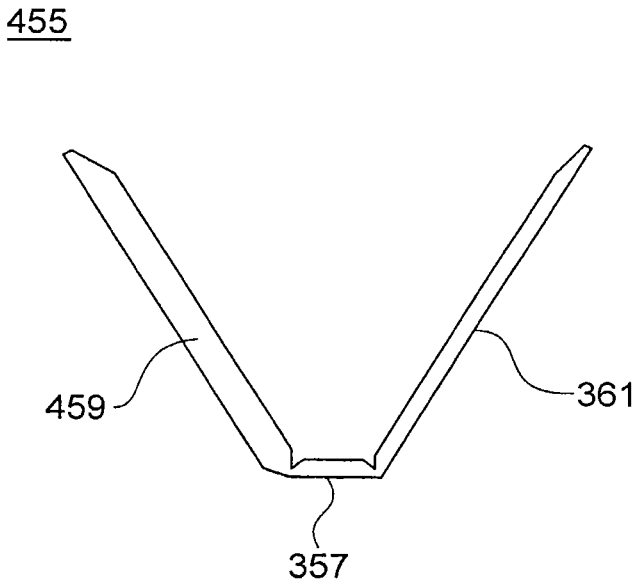


FIG. 19



BALUSTRADE DEVICE FOR CONVEYOR

TECHNICAL FIELD

The present invention relates to a balustrade device for a conveyor.

BACKGROUND ART

Structures for holding a balustrade panel of a passenger conveyor, in particular, structures for fixing a glass are required to grip the glass with a sufficient force so as to prevent displacement of the glass due to the gravity, passengers' tampering, or collision of objects.

As a glass holding structure that satisfies the above-mentioned requirement, there are known a structure for causing an axial force of a bolt to directly act as a pressing force through an intermediation of a plate, and a structure for amplifying the pressing force on the wedge principle.

The first structure for pressing the plate may be simple but is required to cause the axial force of the bolt to act on the balustrade panel at a right angle, to thereby generate a necessary gripping force. As a result, there arise drawbacks such as increase in device size, material cost, and weight, and tightness in the internal space.

As the second structure, on the other hand, a structure disclosed in, for example, JP 07-17337 B is known. This structure attains light-weighting and space saving, but the shape of each component is relatively complex, and hence it is difficult to manufacture the component by sheet metal working. Further, a relatively accurate surface is required to slide the component, and hence the manufacturing method is limited to metal casting that involves machining, or to injection molding (die casting). As a result, there arise drawbacks such as increase in processing cost and investment in molds.

In contrast, JP 07-25572 A discloses a wedge-type glass holding structure manufactured by aluminum extrusion molding, which is lower in cost of molds than the die casting (generally 1/10 to 1/20).

However, the extrusion molding is limited to manufacture of components having two-dimensional shapes, and hence it is difficult to obtain a structure for generating a sufficient holding force. In actuality, the structure disclosed in JP 07-25572 A is more difficult in exerting a sufficient gripping force than the structure disclosed in JP 07-17337 B.

CITATION LIST

Patent Literature

[PTL 1] JP 07-17337 B
[PTL 2] JP 07-25572 A

SUMMARY OF INVENTION

Technical Problem

The present invention has been made in view of the above-mentioned circumstances, and it is therefore an object of the present invention to provide a balustrade device for a conveyor, which is capable of generating a high gripping force in spite of its two-dimensional shape.

Solution to Problem

In order to attain the above-mentioned object, according to one embodiment of the present invention, there is provided a balustrade device for a conveyor, including at least: a holder body; a clamping component assembled to the holder body; and a clamping force applying mechanism. The clamping component has a panel-side pressing surface, and the clamping force applying mechanism has a clamping force action axis intersecting, in vertical cross-sectional view, with the panel-side pressing surface or a plane extending from the panel-side pressing surface.

Advantageous Effects of Invention

According to one embodiment of the present invention, a high gripping force can be generated in spite of the two-dimensional shape.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a vertical cross-sectional view illustrating an assembled state of a balustrade device for a passenger conveyor according to a first embodiment of the present invention.

FIG. **2** is a vertical cross-sectional view illustrating a disassembled state of the balustrade device for a passenger conveyor of FIG. **1**.

FIG. **3** is an explanatory view illustrating evaluation of a clamping force to be generated in a structure of a comparative example.

FIG. **4** is an explanatory view illustrating evaluation of a clamping force to be generated in the balustrade device for a conveyor according to the first embodiment of the present invention.

FIG. **5** is a view illustrating a second embodiment of the present invention in the same manner as that of FIG. **1**.

FIG. **6** is a view illustrating the second embodiment of the present invention in the same manner as that of FIG. **2**.

FIG. **7** is a view illustrating a third embodiment of the present invention in the same manner as that of FIG. **1**.

FIG. **8** is a view illustrating the structure of FIG. **7** as seen in a direction of the arrow VIII.

FIG. **9** is a view illustrating the structure of FIG. **7** as seen in a direction of the arrow IX.

FIG. **10** is a view illustrating a procedure of assembling the balustrade device for a conveyor according to the third embodiment of the present invention.

FIG. **11** is a view illustrating the procedure of assembling the balustrade device for a conveyor according to the third embodiment of the present invention.

FIG. **12** is a schematic perspective view illustrating panel support through use of a balustrade device for a conveyor according to a fourth embodiment of the present invention.

FIG. **13** is an end view illustrating a rail-like component according to the fourth embodiment of the present invention.

FIG. **14** is an end view illustrating a cushioning member according to the fourth embodiment of the present invention.

FIG. **15** is a view illustrating a procedure of assembling the balustrade device for a conveyor according to the fourth embodiment of the present invention.

FIG. **16** is a view illustrating the procedure of assembling the balustrade device for a conveyor according to the fourth embodiment of the present invention.

FIG. **17** is a view illustrating the procedure of assembling the balustrade device for a conveyor according to the fourth embodiment of the present invention.

FIG. **18** is a view illustrating the procedure of assembling the balustrade device for a conveyor according to the fourth embodiment of the present invention.

FIG. **19** is a view illustrating a fifth embodiment of the present invention in the same manner as that of FIG. **14**.

DESCRIPTION OF EMBODIMENTS

Now, a balustrade device for a conveyor according to embodiments of the present invention is described with reference to the accompanying drawings. Note that, in the drawings, the same reference symbols represent the same or corresponding parts. Note that, in each of the following embodiments, a balustrade device for an escalator, which is one of the passenger conveyors, is described as the balustrade device for a conveyor.

First Embodiment

FIG. **1** is a vertical cross-sectional view illustrating an assembled state of a balustrade device for a passenger conveyor according to a first embodiment of the present invention. FIG. **2** is a vertical cross-sectional view illustrating a disassembled state of the balustrade device for a passenger conveyor of FIG. **1**.

Note that, the vertical cross sections of the balustrade device illustrated in FIGS. **1** and **2** are cross sections orthogonal to a conveyance direction of the conveyor or cross sections taken in the vertical direction intersecting with the conveyance direction.

A balustrade device **1** for a passenger conveyor according to the first embodiment includes at least a panel holder including a holder body **3** and a clamping component **5**, and a clamping force applying mechanism **7**. In brief, the balustrade device **1** for a passenger conveyor is configured to sandwich a balustrade panel **9**, such as a glass panel, between the holder body **3** and the clamping component **5**, and to apply a necessary clamping force by the clamping force applying mechanism **7**.

The holder body **3** has such a shape that an aluminum extruded product is sliced into a cross section at a predetermined length (about 60 mm to 120 mm). Note that, the length refers to a dimension in a direction orthogonal to the drawing sheet of FIG. **1**. The balustrade device **1** for a conveyor is fixed to a truss structure (not shown) through an intermediation of a bracket (not shown). A groove **11**, into which the bracket is to be coupled, is formed in a left side surface of the holder body **3** in the drawing sheet.

A recessed portion **13** for receiving the clamping component **5** is formed in an upper right region of the holder body **3** in the drawing sheet. In the vertical cross-sectional view of FIG. **2**, the recessed portion **13** is a U-shaped or V-shaped groove. Further, in the vertical cross-sectional view of FIG. **2**, the recessed portion **13** is defined by a panel receiving surface **15**, a clamping component-side abutment surface **17**, and a bottom surface **19**, and is opened on an upper side of the recessed portion **13**.

The panel receiving surface **15** and the clamping component-side abutment surface **17** have a relationship of being inclined with respect to each other so as to gradually reduce an interval therebetween toward the bottom surface **19** side. That is, the recessed portion **13** has such a cross-sectional shape that the space defined by the recessed portion **13** is gradually reduced toward the bottom surface **19** side.

At the time of clamping operation, the clamping component-side abutment surface **17** is configured to guide an advancing direction of the clamping component **5**, and to receive a reaction force that the clamping component **5** receives from the balustrade panel **9**. In the example of the first embodiment, the clamping component-side abutment surface **17** is inclined with respect to the panel receiving surface **15** by 10° to 30°.

A bolt fitting groove **21** for fitting a head of the bolt described later, which is a part of the clamping force applying mechanism **7**, is formed in the bottom surface **19**. Further, the bottom surface **19** is formed horizontally, and is orthogonal to the panel receiving surface **15**, but the present invention is not limited thereto.

The clamping component **5** is an aluminum extruded product similarly to the holder body **3**, and is larger in length dimension than the holder body **3** by about 10 mm to 20 mm. The clamping component **5** has a panel-side pressing surface **23** and a holder body-side abutment surface **25** at both side portions thereof. In the first embodiment, the holder body-side abutment surface **25** and the clamping component-side abutment surface **17** of the holder body **3** have a relationship of being brought into contact with and slidable with respect to each other. Further, the panel-side pressing surface **23** and the balustrade panel **9** have a relationship of being brought into contact with and slidable with respect to each other.

The panel-side pressing surface **23** and the holder body-side abutment surface **25** have a relationship of being inclined with respect to each other so as to gradually reduce an interval therebetween toward the bottom surface **19** side of the recessed portion **13**. Further, a through hole (including a shape of cutouts) **27** for a shank of the bolt described later, which is a part of the clamping force applying mechanism **7**, is formed in the clamping component **5**. An axis (A) of the through hole **27** is positioned between the panel-side pressing surface **23** and the holder body-side abutment surface **25** in the drawing sheet of FIG. **2**.

The clamping force applying mechanism **7** includes, for example, a bolt **29**, a fixing nut **31**, and a clamping force applying nut **33**. Under a state in which a head of the bolt **29** is received in the bolt fitting groove **21**, the fixing nut **31** is tightened so that the bolt **29** is fixed into the recessed portion **13**. In addition, under a state in which the clamping component **5** is fitted onto a shank of the bolt **29**, the clamping force applying nut **33** is tightened from above the clamping component **5** so as to cause the clamping component **5** to apply a clamping force.

A clamping force action axis F of the clamping force applying mechanism **7** intersects, in vertical cross-sectional view, with the panel-side pressing surface **23** or a plane (B) extending from the panel-side pressing surface **23**. Note that, it is assumed that the intersection is limited to a state of intersection occurring on a distal end side of the arrow indicating the clamping force action axis F. In other words, the intersection refers to intersection occurring in a region below the clamping component **5** in the drawing sheet of FIG. **2**.

Further, in the first embodiment, the clamping force action axis F of the clamping force applying mechanism **7** extends, in vertical cross-sectional view, between the panel-side pressing surface **23** (including the plane (B) extending from the panel-side pressing surface **23**) and the holder body-side abutment surface **25** (including a plane (C) extending from the holder body-side abutment surface **25**). Further, the axis (A) of the through hole **27**, that is, the clamping force action axis F, the holder body-side abutment surface **25**, and the plane (C) extending from the holder body-side abutment surface **25** are set to a parallel relationship.

The panel holder is configured to fix the balustrade panel **9** through a reliable operation using the clamping component **5** that utilizes the wedge principle. Further, the bolt **29** is fixed in parallel to the advancing direction of the clamping component **5**, and the bolt fitting groove **21**, the through hole **27**, and the bolt **29** are provided so that the clamping force action axis F, the holder body-side abutment surface **25**, and the

plane (C) extending from the holder body-side abutment surface **25** become parallel to each other.

Next, description is given of excellent functions of the balustrade device for a conveyor according to the first embodiment, which is constructed as described above. Firstly, referring to FIG. **3**, description is given of a clamping force to be generated in the structure disclosed in Patent Literature 2 (JP 07-25572 A) as a comparative example. Subsequently, referring to FIG. **4**, description is given of a clamping force to be generated in the balustrade device for a conveyor according to the first embodiment.

Note that, the meanings of the symbols to be used in the following description are as follows.

F: clamping force action axis=tightening force (axial force) of bolt

P: reaction force (gripping force) received by clamping component from balustrade panel

N: reaction force received by clamping component from holder body

μ_1: coefficient of friction between clamping component and holder body

μ_2: coefficient of friction between clamping component and balustrade panel

θ: angle formed between panel receiving surface and clamping component-side abutment surface (advancing direction of clamping component)

Firstly, as illustrated in FIG. **3**, in the structure of the comparative example, the balance between the forces acting on the clamping component has the following relationships in terms of two axes orthogonal to each other.

[Math. 1]

$$P=N(\cos\theta-\mu_1\sin\theta) \tag{1}$$

[Math. 2]

$$\mu_2 P+N(\sin\theta+\mu_1\cos\theta)=F \tag{2}$$

When Expression (2) is transformed so that the reaction force N received by the clamping component from the holder body is expressed by the axial force F and the gripping force P, the following expression is obtained.

[Math. 3]

$$N=\frac{F-\mu_2 P}{\sin\theta+\mu_1\cos\theta} \tag{3}$$

When Expression (3) is then substituted into Expression (1) to eliminate the reaction force N, the following expression is obtained.

[Math. 4]

$$P=\frac{F-\mu_2 P}{\sin\theta+\mu_1\cos\theta}(\cos\theta-\mu_1\sin\theta) \tag{4}$$

Further, when Expression (4) is transformed so that the gripping force P is expressed by the axial force F, the following expression is obtained.

[Math. 5]

$$P=\frac{\cos\theta-\mu_1\sin\theta}{(1-\mu_1\mu_2)\sin\theta+(\mu_1+\mu_2)\cos\theta}F \tag{5}$$

When μ_1, μ_2, and θ in Expression (5) are changed to calculate multiplication factors for the axial force F with respect to the gripping force P under the respective conditions, the results are as shown in Table 1. Note that, for convenience of the calculation, it is assumed that $\mu_1=\mu_2=\mu$.

TABLE 1

	θ				
μ	10°	15°	20°	25°	30°
0	5.67	3.73	2.75	2.14	1.73
0.1	2.62	2.09	1.72	1.44	1.22
0.2	1.69	1.44	1.24	1.07	0.93
0.3	1.25	1.09	0.96	0.84	0.73
0.4	0.98	0.87	0.77	0.68	0.60
0.5	0.81	0.72	0.64	0.57	0.50
0.6	0.68	0.61	0.55	0.48	0.42
0.7	0.59	0.53	0.47	0.41	0.35
0.8	0.52	0.46	0.41	0.35	0.30

Similarly to the above, in the balustrade device for a conveyor according to the first embodiment, as illustrated in FIG. **4**, the following two expressions are firstly obtained as the relationships for the balance between the forces.

[Math. 6]

$$P=F\sin\theta+N(\cos\theta-\mu_1\sin\theta) \tag{6}$$

[Math. 7]

$$N=P(\cos\theta-\mu_2\sin\theta) \tag{7}$$

When the reaction force N is then eliminated based on Expressions (6) and (7), the following expression is obtained.

[Math. 8]

$$P=F\sin\theta+P(\cos\theta-\mu_2\sin\theta)(\cos\theta-\mu_1\sin\theta) \tag{8}$$

Further, when Expression (8) is transformed so that the gripping force P is expressed by the axial force F, the following expression is obtained.

[Math. 9]

$$P=\frac{1}{(1-\mu_1\mu_2)\sin\theta+(\mu_1+\mu_2)\cos\theta}F \tag{9}$$

When $\mu(\mu_1=\mu_2=\mu)$ and θ in Expression (9) are similarly changed to calculate multiplication factors for the axial force F with respect to the gripping force P under the respective conditions, the results are as shown in Table 2.

TABLE 2

	θ				
μ	10°	15°	20°	25°	30°
0	5.76	3.86	2.92	2.37	2.00
0.1	2.71	2.23	1.90	1.67	1.50
0.2	1.78	1.58	1.42	1.30	1.21
0.3	1.34	1.23	1.14	1.08	1.03
0.4	1.07	1.01	0.96	0.93	0.90
0.5	0.90	0.86	0.84	0.82	0.81

TABLE 2-continued

	θ				
μ	10°	15°	20°	25°	30°
0.6	0.77	0.75	0.74	0.74	0.74
0.7	0.68	0.67	0.67	0.67	0.68
0.8	0.61	0.61	0.61	0.62	0.64

As is apparent from comparison between Tables 1 and 2, when the friction is ignored, for example, when μ=0 and θ=10°, P=5.67 F in the comparative example and P=5.76 F in the first embodiment, which exhibits no significant difference between the comparative example and the first embodiment. Under actual conditions that the friction cannot be ignored, it is understood that the influence of the friction is significant. Within a realistic range in which μ=0.4 to 0.8, in the related-art structure as in the comparative example, the gripping force is significantly attenuated with respect to the tightening force of the bolt, whereas in this embodiment, the tightening force is not significantly lost so that a gripping force of 120% to 200% as compared to the related-art structure can be generated.

As described above, according to the first embodiment, the inventive cross-sectional shape obtained by forming the clamping component-side abutment surface parallel to the wedge advancing direction, the bolt fitting groove, and the like is introduced in the extrusion molding. Thus, it is possible to attain a panel holding structure capable of generating a high holding force in spite of its shape limited to the two-dimensional shape due to the extrusion. Further, with the above-mentioned excellent effect, three-dimensional molding is unnecessary, which means that there is also attained an advantage in that the use of expensive molds is not required unlike aluminum die casting. Still further, the holder body and the clamping component are obtained by only slicing an extruded material into cross sections, and hence the productivity is also excellent significantly. Still further, the clamping component is longer than the holder body, and hence the clamping component slightly projects with respect to the holder body during assembly. This projecting state is utilized so that the clamping component can be removed from the holder body by applying a load to the projecting portion from below, with the result that the workability is enhanced.

Second Embodiment

Next, referring to FIGS. **5** and **6**, a balustrade device for a conveyor according to a second embodiment of the present invention is described. FIGS. **5** and **6** are views illustrating the second embodiment in the same manners as those of FIGS. **1** and **2**, respectively.

A holder body **103** of a balustrade device **101** for a conveyor according to the second embodiment has a bolt fitting groove **121** formed not in a bottom surface **119** of the recessed portion **13** but outside the recessed portion **13**. Along with this, in a clamping component **5**, the axis (A) of the through hole **27** is positioned outside a region defined between the plane (B) extending from the panel-side pressing surface **23** and a plane (C) extending from a holder body-side abutment surface **125**.

Comparing the clamping component according to the second embodiment with the clamping component according to the first embodiment, it can be said that the clamping component according to the second embodiment has a shape in which a clamping force receiving portion **105***a* is extended so that the axis (A) of the through hole **27** is positioned outside the region defined between the plane (B) extending from the panel-side pressing surface **23** and the plane (C) extending from the holder body-side abutment surface **125**. Alternatively, it can conversely be said that the clamping component according to the second embodiment has a shape in which the region of the clamping component **105** is reduced so that the holder body-side abutment surface **125** is brought closer to the panel-side pressing surface **23**.

Also with the above-mentioned balustrade device **101** for a conveyor according to the second embodiment, similarly to the first embodiment, a high gripping force can be generated in spite of the two-dimensional shape.

Third Embodiment

Next, referring to FIGS. **7** to **11**, a balustrade device for a conveyor according to a third embodiment of the present invention is described. FIG. **7** is a view illustrating the third embodiment in the same manner as that of FIG. **1**. FIGS. **8** and **9** are views illustrating the structure of FIG. **7** as seen in directions of the arrows VIII and IX, respectively.

In a balustrade device **201** for a conveyor according to the third embodiment, a holder body having a clamping component and a clamping force applying mechanism assembled thereto is fixed to a truss structure (fixing member) **239** of the passenger conveyor through use of two brackets **235** and **237** in combination. Thus, the positioning work at the time of holding the balustrade panel is facilitated. Note that, the clamping component, the clamping force applying mechanism, and the holder body have the same structures as those in the above-mentioned first or second embodiment. In the example of FIGS. **7** to **11**, the clamping component, the clamping force applying mechanism, and the holder body have the same structures as those in the first embodiment.

The brackets **235** and **237** are two sheet metal components each having, for example, an L-shaped end surface. The bracket to be connected to the holder body **3** is referred to as "adjusting bracket **235**," and the bracket to be connected to the truss structure **239** is referred to as "mounting bracket **237**." In some cases, brackets having the same dimensions may be used as the brackets **235** and **237**.

A surface of the adjusting bracket **235**, which is not fastened to the holder body **3**, and a surface of the mounting bracket **237**, which is not fastened to the truss structure **239**, are fastened to each other through use of bolts serving as fasteners. The two brackets **235** and **237** are held by a frictional force generated due to axial forces of the bolts, and hence the size and number of the bolts only need to be selected based on an assumed external force.

At least one elongate hole **241** for adjusting the height and horizontal alignment position of the holder body **3** (horizontal direction in the drawing sheet of FIG. **9**) is formed in the adjusting bracket **235** and/or the mounting bracket **237**. For example, in the third embodiment, a plurality of the elongate holes **241** are formed in the mounting bracket **237** on a side connected to the truss structure **239**, and in the adjusting bracket **235** on a side connected to the mounting bracket **237**.

Further, the mounting structure is set so that the bolts are inserted into the respective elongate holes **241**, and hence the structure is capable of adjusting slide and rotation between the two brackets **235** and **237** and between the mounting bracket **237** and the truss structure **239**.

Due to the adjusting mechanism as described above, as a jig for adjusting the position of the holder body **3**, a panel dummy, which is a plate having a thickness equal to that of the panel, may be arranged at an ideal panel position with respect to a reference position (rail for steps and truss).

Further, referring to FIGS. **10** and **11**, description is given of a procedure of assembling the balustrade device for a conveyor according to the third embodiment. Firstly, as illustrated in FIG. **10**, the adjusting bracket **235** is fixed to the

holder body **3**. The adjusting bracket **235** and the mounting bracket **237** are temporarily assembled to each other under a state in which the bolts are loosened, and the mounting bracket **237** and the truss structure **239** are also temporarily assembled to each other under a state in which the bolts are loosened.

Subsequently, through use of the adjusting jig, a panel dummy **243** is arranged at an ideal position (height, horizontal alignment, and inclination) with respect to the reference. Then, the clamping force applying mechanism **7** is operated so as to cause the clamping component **5** to apply a necessary clamping force, to thereby temporarily hold the panel dummy **243** in a similar state to an ideal holding state of the balustrade panel **9** to be intended.

In this state, the bolts temporarily tightened as described above are tightened appropriately so that the adjusting bracket **235** and the mounting bracket **237** are finally assembled to each other, and the mounting bracket **237** and the truss structure **239** are also finally assembled to each other. In this manner, the holder body **3** is finally fixed.

Then, the clamping force applying mechanism **7** is loosened so as to reduce the clamping force of the clamping component **5**, to thereby remove the panel dummy **243**. Thus, the holder body **3** remains in a state of being capable of holding the balustrade panel **9** in an ideal manner to be intended.

With the above-mentioned balustrade device for a conveyor according to the third embodiment, in addition to the above-mentioned functions of the first embodiment and/or the second embodiment, there is further attained an advantage of easily and highly accurately carrying out the positional adjustment of the panel fixing structure, which is necessary to highly accurately reproduce the horizontal alignment position, height, and verticality of the inner panel, at an assembly plant of the passenger conveyor or a building site.

Fourth Embodiment

Next, referring to FIGS. **12** to **18**, a balustrade device for a conveyor according to a fourth embodiment of the present invention is described. FIG. **12** is a schematic perspective view illustrating panel support through use of a balustrade device **301** for a conveyor according to the fourth embodiment.

The balustrade device **301** for a conveyor according to the fourth embodiment includes a holder body supported by a fixing member through use of appropriate brackets, a clamping component, a clamping force applying mechanism, a rail-like component, and a cushioning member. Note that, as a specific example, the holder body **3**, the clamping component **5**, the clamping force applying mechanism **7**, the adjusting bracket **235**, and the mounting bracket **237** described above are used, and the fixing member is the truss structure **239**.

A rail-like component **345** is a steel component having a thickness of about 1.0 mm to 1.6 mm. The rail-like component **345** is arranged at a lower portion of the balustrade panel **9** over the entire length of the passenger conveyor. As illustrated in FIG. **13**, the rail-like component **345** includes a bottom wall **347** to be brought into contact with the bottom surface **19** of the recessed portion **13** of the holder body **3**, a side wall **349** to be brought into contact with the panel receiving surface **15**, a side wall **351** to be brought into contact with the panel-side pressing surface **23**, and at least one edge surface **353** for supporting a deck board described later. In other words, the rail-like component **345** is a member having an upwardly open groove defined by the bottom wall **347** and the pair of side walls **349** and **351**, for receiving the balustrade panel **9**.

The edge surface **353** is apart to be used for reinforcing the deck board described later. In this embodiment, the edge surfaces **353** are formed in pairs, and extend outwardly from upper ends of the corresponding side walls **349** and **351**, respectively.

As illustrated in the end view of FIG. **13**, the bottom wall **347** and the pair of side walls **349** and **351** define a C-shape opened upwardly. Further, under a natural state illustrated in FIG. **13**, a width between the upper ends of the pair of side walls **349** and **351** under the natural state, that is, an opening width (E) is set slightly larger than an inner upper surface width (D) of the bottom wall **347**. This is because an angle (F) formed between the bottom wall **347** and the side wall **349** and an angle (F) formed between the bottom wall **347** and the side wall **351** are slightly larger than 90°.

As described above, under the natural state, upper surface width (D)<opening width (E), but when the clamping force applying mechanism **7** is operated in use so as to sandwich the balustrade panel **9** between the holder body **3** and the clamping component **5**, the rail-like component **345** is elastically deformed, and hence the upper opening is slightly narrowed, with the result that upper surface width (D)=opening width (E).

As illustrated in FIG. **14**, under a natural state, a cushioning member **355** has a substantially V-shaped end surface in which the bottom portion is wide and flat to some extent. The cushioning member **355** includes a bottom wall **357**, and a pair of side walls **359** and **361** extending from both ends of the bottom wall **357**. Note that, the cushioning member **355** is not limited to the example illustrated in FIG. **14** as long as the cushioning member **355** includes a pair of side walls capable of changing an interval and an angle therebetween under the natural state and the assembled state.

Further, the cushioning member **355** is a soft resin molded product, and is larger in length than the holder body **3** by about 10 mm to 20 mm. When the cushioning member **355** is received in the recessed portion **13** as described later, the cushioning member **355** has a height substantially equal to that of the panel receiving surface **15** and sufficiently smaller than that of the rail-like component **345**.

Still further, an outer lower surface width (G) of the bottom wall **357** of the cushioning member **355** is substantially equal to the inner upper surface width (D) of the bottom wall **347** of the rail-like component **345**, that is, "outer lower surface width (G)"="inner upper surface width (D)"="thickness of balustrade panel **9**+total thickness of pair of side walls **359** and **361** of cushioning member **355**." In this manner, the width and height of the cushioning member **355** are set to such a size that the cushioning member **355** may exactly be received on an inner side of the rail-like component **345**.

Still further, under the natural state, an angle (H) formed between the bottom wall **357** and each of the side walls **359** and **361** of the cushioning member **355** is set considerably larger than 90°. Under a state in which the cushioning member **355** is elastically deformed and arranged on the inner side of the rail-like component **345**, the cushioning member **355** adheres to the inner side of the rail-like component **345** due to a restoring force.

Next, referring to FIGS. **15** to **18**, description is given of a procedure of assembling the balustrade device for a conveyor according to the fourth embodiment. Firstly, as a preparatory stage in advance, a state as illustrated in FIG. **15** is attained in a plant or a work site if necessary. That is, the holder body **3** is fixed to the truss structure **239** through an intermediation of the adjusting bracket **235** and the mounting bracket **237**, and the clamping component **5**, the clamping force applying

mechanism **7**, and the rail-like component **345** are arranged in the recessed portion **13** of the holder body **3**.

Note that, at this stage, the clamping force applying mechanism **7** is sufficiently loosened so as to raise the position of the clamping component **5** to an upper side of the recessed portion **13**. Further, the rail-like component **345** at this time is slightly opened under the natural state as described above, and hence the clamping component **5** is lightly sandwiched between the rail-like component **345** and the clamping component-side abutment surface **17** of the holder body **3**. Thus, even without any special support, the position of the clamping component **5** is prevented from being lowered due to the self-weight.

Further, at this stage, packings **363** are fixed to the pair of the edge surfaces **353** of the rail-like component **345**, respectively. Still further, an outer deck **365** is fixed to one of the packings **363**, and an inner deck (not shown) is finally fixed to the other of the packings **363**.

Then, as a first stage, as illustrated in FIG. **16**, the cushioning member **355** is inserted to the inner side of the rail-like component **345**. At this time, the rail-like component **345** is opened wider than at the time of panel supporting operation, and hence the opening portion of the rail-like component **345** becomes slightly wider than the bottom surface. The cushioning member **355** is elastically deformed and inserted through the relatively wider opening portion so that the opening of the pair of side walls **359** and **361** is narrowed. The cushioning member **355** thus inserted adheres to the inner surface of the rail-like component **345** due to the restoring force of the cushioning member **355** to be opened on the inner side of the rail-like component **345**.

Subsequently, as a second stage, as illustrated in FIG. **17**, the balustrade panel **9** is inserted to the inner side of the cushioning member **355** arranged in the rail-like component **345**. In this state, the clamping force applying mechanism **7** is still loosened, and hence the balustrade panel **9** is slightly movable between the holder body **3** and the clamping component **5**, thereby being capable of desirably adjusting the inclination, the position in the height direction, the position in the longitudinal direction, and the like. Note that, the rail-like component **345** and the cushioning member **355** described above are interposed between the balustrade panel **9** and the holder body **3** and between the balustrade panel **9** and the clamping component **5**, and hence, even when the worker releases his/her hands, the balustrade panel **9** does not wobble significantly so that the balustrade panel **9** stands by itself in a substantially constant state. This leads to the fact that fine adjustment of the position and posture of the balustrade panel **9** can be carried out safely, easily, and reliably.

Finally, as a third stage, as illustrated in FIG. **18**, the clamping force applying mechanism **7** is operated so as to cause the clamping component **5** to apply a clamping force. Thus, the position of the clamping component **5** is lowered, and the rail-like component **345** and the cushioning member **355** are deformed, with the result that the balustrade panel **9** is fixed securely.

With the above-mentioned balustrade device for a conveyor according to the fourth embodiment, in addition to the above-mentioned functions of the first to third embodiments, the balustrade panel can be fixed easily and highly accurately. Further, the rail-like component is arranged at the lower end of the balustrade panel over the entire length, which leads to an advantage in that, even if the balustrade panel is broken, the broken pieces of the panel can be prevented from falling into the devices of the passenger conveyor.

Fifth Embodiment

Next, referring to FIG. **19**, a balustrade device for a conveyor according to a fifth embodiment of the present invention is described. FIG. **19** is a view illustrating the fifth embodiment in the same manner as that of FIG. **14**. In the fifth embodiment, the structure of the cushioning member according to the fourth embodiment is changed as described below.

As illustrated in FIG. **19**, in a cushioning member **455**, the side wall **361** on the inner side (step side), which is the clamping component **5** or **105** side, is formed at a similar thickness to that in the above-mentioned fourth embodiment, and a side wall **459** on the outer side, which is the panel receiving surface **15** side, is formed thicker or thinner than the side wall **361**. Note that, FIG. **19** illustrates an example of a thick side wall **459**. That is, the two surface parts of the cushioning member **455** for covering the side surfaces of the balustrade panel **9** are required to have a thickness that exactly fills the space between the lower end of the balustrade panel **9** and the rail-like component **345**. Therefore, a plurality of types of thickness are prepared for the side wall **459** of the cushioning member **455**, and the thickness is selected depending on the thickness of the balustrade panel **9** to be used.

With the above-mentioned balustrade device for a conveyor according to the fifth embodiment, the following advantages are attained in addition to the above-mentioned functions of the first to fourth embodiments. For example, even when a balustrade panel set to high-strength specifications and therefore thicker than a standard balustrade panel is to be fixed as well as the balustrade panel set to the standard specifications, it is only necessary to change the cushioning member and prepare only one type for the other components. Thus, it is unnecessary to change the components, set dimensions, and assembly procedures. Further, even when it is desired to change the thickness of only a balustrade panel at a specific position in the same passenger conveyor, the balustrade panel may be fixed through the change and selection of the corresponding cushioning member. Still further, in some specifications of the passenger conveyor, a stainless steel panel is used as well as the glass balustrade panel, and hence the internal structure is different from that of the glass type in the related art. In this embodiment, however, a cushioning member having a predetermined thickness conforming to the stainless steel panel is used, and thus the present invention can be carried out by using the structure of the glass type in other positions.

The details of the present invention have been described above specifically with reference to the preferred embodiments, but it is apparent that a person skilled in the art may employ various modifications based on the basic technical thoughts and teachings of the present invention.

For example, the present invention is not limited to the escalator as the passenger conveyor, but is also applicable to a moving walkway. Further, the present invention is not limited to the application to the conveyor configured to convey passengers, but may widely be applicable to a conveyor configured to convey other objects than people.

Reference Signs List

1, **101**, **201**, **301** balustrade device for conveyor, **3**, **103** holder body, **5**, **105** clamping component, **7** clamping force applying mechanism, **9** balustrade panel, **13** recessed portion, **23** panel-side pressing surface, **25** holder body-side abutment surface, **235** adjusting bracket, **237** mounting bracket, **241** elongate hole, **345** rail-like component

The invention claimed is:

1. A balustrade device for a conveyor, comprising:

a holder body;

a clamping component assembled to the holder body; and

a clamping force applying mechanism,

the clamping component having a panel-side pressing surface,

the clamping force applying mechanism having a clamping force action axis intersecting, in vertical cross-sectional view, with the panel-side pressing surface or a plane extending from the panel-side pressing surface,

wherein the clamping force action axis intersects with the panel-side pressing surface or a plane extending from the panel-side pressing surface at an angle from 10° to 30°.

2. A balustrade device for a conveyor according to claim **1**,

wherein the holder body has a recessed portion formed therein, for receiving the clamping component,

wherein the clamping component has the panel-side pressing surface and a holder body-side abutment surface at both side portions thereof,

wherein the panel-side pressing surface and the holder body-side abutment surface have a relationship of being inclined with respect to each other so as to gradually reduce an interval therebetween toward a bottom portion side of the recessed portion, and

wherein the clamping force action axis of the clamping force applying mechanism extends, in vertical cross-sectional view, between the panel-side pressing surface and the holder body-side abutment surface.

3. A balustrade device for a conveyor according to claim **1**, further comprising an adjusting bracket and a mounting bracket arranged between a fixing member of the conveyor and the holder body,

wherein the adjusting bracket and the mounting bracket are connected to each other,

wherein the adjusting bracket is further connected to the holder body,

wherein the mounting bracket is further connected to the fixing member,

wherein the adjusting bracket and the mounting bracket are connected to each other through use of a fastener passing through an elongate hole so that slide and rotation between the adjusting bracket and the mounting bracket are adjustable, and

wherein the mounting bracket and the fixing member are connected to each other through use of a fastener passing through an elongate hole so that slide and rotation between the mounting bracket and the fixing member are adjustable.

4. A balustrade device for a conveyor according to claim **1**, further comprising:

a rail-like component arranged between a panel receiving surface of the holder body and the panel-side pressing surface of the clamping component; and

a cushioning member arranged on an inner side of the rail-like component,

wherein the balustrade device is configured to hold a balustrade panel on an inner side of the cushioning member.

5. A balustrade device for a conveyor according to claim **4**,

wherein the cushioning member comprises a pair of side walls capable of changing an interval and an angle therebetween under a natural state and an assembled state, and

wherein one of the pair of side walls is different in thickness from another of the pair of side walls.

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